# Instructor Manual
# Module

# 5

# Storage and Dispensing Locations

## *Module Objective*

Upon completion of this module, participants should be able to discuss common locations for storage and dispensing of ethanol-blended fuels and will provide a basic understanding of these storage/ dispensing sites.

## *Enabling Objectives*

1. Describe the four common types of storage tanks at tank farm facilities.
2. List potential benefits and challenges associated with fixed fire suppression systems at fuel storage facilities.
3. Prepare a list of agencies that may be called upon for support during an incident at a fuel storage or dispensing location.

***Instructor Note*:**

***Module Time:*** *40 minutes/ 55 minutes*

***Materials:***

- *Activity 5.1*
  - *Worksheet 5.1*
- Emergency Response Considerations *video – (Show the video segment from 9:31 to 12:13)*

***Instructor Note:***

*Show the video* Emergency Response Considerations *(9:31 to 12:13).*

## *Introduction*

***Instructor Note:***

*Ask participants if they know how many ethanol plants there are in the United States.*

- ***Answer**: For the most current information go to [www.EthanolRFA.org](http://www.EthanolRFA.org).*

Often when the response community thinks of storing and dispensing ethanol-blended fuels we fail to think of the retail fueling station on the corner. As a result, we can believe that if there is no bulk storage operation or production operation in our jurisdiction, we have little to worry about. This could not be further from the truth.

Today nearly all gasoline in the U.S. is blended with some level of ethanol. Ethanol and ethanol-blended fuels are found at production facilities, bulk tank farms, rail transload facilities, construction sites and retail fueling stations within your community and throughout the country.

Depending on the size of your jurisdiction or response area, it may be impractical to pre-plan every retail facility offering ethanol-blended fuels. However, it is realistic and highly recommended that standard operating procedures or guidelines (SOP/SOG) be developed to ensure consistency in emergency response addressing life safety, incident stabilization and property conservation.

Therefore, it is important for local emergency responders to be familiar with the facilities in their locations.

## *Storage Tank Types and Designs*

Denatured fuel ethanol is typically stored in conventional carbon steel atmospheric tanks, similar to those used for gasoline and other flammable liquids. Stainless steel tanks may also be used, though they are less common. As consumption increases, the industry is shifting toward larger tank capacities. All ethanol storage tanks must be clearly marked with the contents they store.

At bulk tank farm facilities, there are four main types of above-ground storage tanks commonly used for ethanol and ethanol-blended fuels:

- Horizontal Storage Tanks
- Cone roof and dome roof tanks
- External Floating Roof (EFR) Tank
- Internal Floating Roof (IFR) Tank

Horizontal Storage Tanks:
Horizontal tanks are cylindrical tanks which may be located above or below ground, possibly with built in containment systems. Horizontal tanks may be found and used for ethanol-blended

fuels in bulk storage facilities, retail markets, agriculture applications and private residences where regulatory codes allow.

Cone Roof (Closed-Top) Tanks:
Cone roof tanks are fixed-roof, carbon steel tanks widely used to store flammable liquids such as ethanol.

External Floating Roof (EFR) Tanks:
EFR tanks have open top with a floating pan.

Internal Floating Roof (IFR) Tank:
IFR tanks have closed top and internal floating pan. They are the most common bulk storage tanks for denatured fuel ethanol. (see Figure 5.1 in the Participant Guide)

To address regulatory requirements, vapor control and product integrity, some IFR tanks have been retrofitted from EFR using a geodesic dome type design instead of a conventional carbon steel metal roof. These retrofitted tanks may be used for storage of ethanol-blended fuels.

Lastly, although spherical tanks exist in bulk storage—especially for pressurized gases and petrochemicals, currently there are no known use of these tanks for storage of ethanol-blended fuels. However, as the fuel industry evolves, this may change. Agencies with response or oversight responsibilities should stay informed and develop pre-plans based on the actual tank types in use at local facilities.

**Figure 5.1: Internal Floating Roof Storage Tank**

The most common denatured fuel ethanol bulk storage tanks are internal floating roof (IFR) tanks. Key characteristics to look for on IFR tanks are a closed roof over an internal floating pan, eyebrow venting and fire protection system.

## *Spill Containment*

Spill containment dikes are required to contain the volume of the largest tank within the contained area plus a certain proportion over tank capacity to take into consideration rainfall and ancillary spills during an incident. NFPA states that a minimum of 110% of the capacity of the largest tank in the confinement area. Specific dike containment information can be found in the *NFPA 30, Flammable and Combustible Liquids Code.*

Additional fluid from a firefighting operation could lead to overfilling/breaching of the dike.

## *Fire Protection Systems*

Some storage tanks have fixed (built-in) fire protection systems. Fixed systems are a combination of components including foam concentrate storage, proportioning valves, and delivery devices that are permanently installed to provide fire suppression protection. These same fixed systems can service multiple storage tanks, piping manifolds, and loading and unloading racks.

The systems can be activated manually or by automatic detection device. Topside application foam systems may require much higher application rates for ethanol-blended fuels than for previously stored fuels. Subsurface injection systems may not work at all with ethanol-blended fuels.

Emergency responders should work closely with terminal operators and facility management at liquid product terminals to stay informed about changes in fuel storage and ensure fixed fire protection systems meet current industry standards and codes. They must also understand how to activate these systems, develop pre-plans for bulk storage facilities, assess resource needs for successful incident mitigation, and conduct both functional and full-scale exercises to validate their plans and procedures.

## *Built in Fire Protection Systems*

See correlating slide (module 5, slide 9) for an illustration showing built-in Type I fixed or Type II semi-fixed fire protection system on a bulk storage tank containing ethanol.

The graphic on the left identifies foam solution (in blue) which is foam concentrate properly proportioned and mixed with water and distributed fire protection piping at pre-determined pressures and flow rates. Once the foam solution enters the foam chamber it is agitated and aerated to allow for the foam to expand to manufacturer requirements of 8-10:1 ratio.

At this point the finished foam (as shown in the image in light green) penetrates the wall of the tank, discharged out of a specially designed nozzle which deflects the foam back onto the side wall of the tank. The finished foam sluffs down the inner wall of the tank and gently spreads across the surface of the burning ethanol-blended fuel.

These systems are designed and engineered for each specific installation. During an incident, the actual condition of the fire protection system must be assessed to determine if functional.

Ultimately, emergency responders must plan for the worst possible scenario, i.e., the fire protection system is out of service and Type III or manual foam applications will be initiated if offensive foam operations commence.

In this photograph it is worth noting the biological growth on the side of the bulk storage tank. The exterior of the storage tank "sweats" more profusely when significant amounts of high concentration ethanol blends are present during warmer temperatures. This moisture captures the organic particulates in the atmosphere and ultimately leads to an algae-like growth on the sides of the tank. There will also be biological growth around the eyebrow vents at the top of the tank in internal floating roofs (IFRs).

*Also note the NFPA 704 placard indicating the tank's contents.

## *Foam Deflector Device*

The foam deflector device is attached to most Type II fixed foam chamber discharge outlets. The deflector directs foam down and over a large area of the inside of the tank wall and onto the top of the burning liquid inside of the tank.

It is important to work with bulk storage facility operators to calculate the outage or open available space in gallons above the liquid level in the tank to inform emergency responders whether the product needs to be removed from the tank before operations can begin or allowed to burn off to reduce product in the tank.

Failure to comprehend the available space inside the storage tank could lead to overfill and having ethanol-blended fuel spillage and complicate the incident drastically.

As discussed in the previous section, expansion needs to be taken into consideration. This would be the ratio of volume of foam formed to the volume of solution used to generate the foam. For example, an eight expansion means 800 gallons of foam from 100 gallons of solution. Keep in mind foam drain time will continue throughout operation.

## *Emergency Response Pre-planning*

As discussed consistently throughout this module, pre-planning for potential incidents at liquid product terminals is extremely important. A significant piece of the pre-planning efforts must include consideration for and development of mutual aid partners.

Fire departments that help provide protection to liquid product terminals should have access to high-flow firefighting foam equipment and access to large supplies of compatible Alcohol-Resistant (AR) foam.

Emergency response agencies or organizations should also be aware they may not be able to contend with a terminal fire operation and may need to contact additional outside resources or

assistance to manage an incident of scope and magnitude. Emergency responders are encouraged to establish healthy working relations with these groups and with the storage facilities in their response area prior to an emergency.

## *Emergency Response Planning*

***Instructor Note:***

*Ask participants who "these groups" are.*

- ***Answers** will vary but could include mutual aid with industrial facilities or nearby jurisdictions.*

Fixed fire systems are currently the best protection for bulk storage tanks. Fire department personnel should be extremely familiar with these systems and pre-calculate their required flow rates and resource needs.

They should also pre-plan operations supplying these systems. Practical exercises should be scheduled at least annually to make sure emergency responders are familiar with the pre-plans and operational activities.

In some areas this has been done by establishing caches of AR foam and equipment through consortiums organized among multiple terminal operations, fire departments, state and other organizations or agencies with statutory responsibilities or functional capabilities.

The consortium philosophy is a process of collaboration to develop a significant cache of AR foam concentrates at a pre-determined geographical location properly managed and supervised and available as a regional asset for ethanol-blended fuel incidents. No one agency, department or organization bears the financial burden of buying, storing and managing such a costly resource. Lastly, all organizations should consider and apply for grant funding when available.

## *Key Considerations*

Keep in mind that there are many different challenges involved in firefighting operations at a liquid product terminal. There may be limited access in both the terminal itself and in tank design for firefighting equipment.

At times, some locations may have inadequate water supplies to fight any type of significant fire. Personnel may have to contend with containment dikes and their systems along with miles of exposed product piping. Liquid product terminals may also have loading racks subject to fire emergencies.

Liquid product terminal operations can be very complicated and responding to a fire emergency can be very dangerous to personnel. It is also not unusual for terminals that were originally built-in remote areas to now be surrounded by commercial and residential growth.

## *Working Relationships*

We cannot over-emphasize that pre-planning is extremely important as are pre-established working relations between the fire department and the facility operators.

The absolute backbone to successfully managing an incident involving ethanol-blended fuel is ensuring an excellent working relationship with the bulk storage owners, vendors and agencies or organizations that have statutory responsibilities and/or functional capabilities.

Also, consider contracting with private flammable liquid firefighting organizations if possible.

## *Terminal Size Considerations*

Smaller bulk distribution storage facilities may pose unique challenges to local fire departments. These facilities are located throughout communities to better distribute fuel to end-users. Storage tanks in these facilities can be a multitude of styles and layouts depending on age and location. Storage tanks may be vertical, horizontal, or a combination of both.

Normally flammable liquid fuels, including gasoline and ethanol-blended fuel, are stored at these facilities in modest quantities. Most of these facilities do not have built-in fire protection systems. These facilities are normally designed with limited fuel spillage containment structures or dikes and are typically unstaffed.

Large bulk distribution storage facilities also pose unique challenges to local fire departments. Storage tanks in these facilities have high-capacity storage and high product transfer capabilities.

A variety of different storage tanks may be present: vertical, horizontal, above-ground or below-ground, or a combination of all of these. Flammable liquids including gasoline and ethanol-blended fuel are stored at these facilities in significant quantities. These facilities have detailed emergency response plans due to the shear volumes stored on-site.

Pre-established working relations between the emergency responders and the facility operators is extremely important. Pre-planning cannot be over-emphasized.

Depending on the age of the bulk storage facility and geographic location, fixed or semi-fixed foam fire protection systems may be found. The capabilities and limitations of these systems can only be determined through extensive familiarization and functional training.

## *Group Discussion*

***Instructor Note:***

*Ask participants if they are aware of any of these types of facilities in their jurisdictions.*

- ***Answers** will vary.*

*Follow up by asking participants if they have planned their response to potential incidents at these facilities.*

## *Storage at a Production Facility*

Both denatured and undenatured or neat ethanol can be stored at a production facility although the most common is denatured fuel ethanol (E95-E98). Ethanol-blended fuels found at retail fuel stations are not generally found at a production facility.

There will be denaturant such as natural gasoline or unleaded gasoline stored at a production facility. Denaturants are added to ethanol through inline blending systems prior to the final product storage tanks.

A typical example is shown in this photo. In this tank configuration ethanol would be stored in the tanks identified as 1 & 2. The denaturant would be stored in the tank identified as 3.

## *Retail Dispensing Stations*

Currently, there are approximately 150,000 retail fueling stations throughout the U.S. Geography, throughput volume or sales, fire code and many other variables impact whether an above-ground or below-ground storage tank is used.

Above-ground storage tanks can be either vertical or horizontal in design. Nearly all underground storage tanks are horizontal. Inventory is brought to the retail station by cargo tank trucks and transferred directly into the underground storage tanks.

Some jurisdictions have hundreds of retail fueling stations selling ethanol-blended fuel. Pre-planning each retail facility would be extremely time-consuming and labor-intensive. Since these facilities must be constructed and maintained to nationally recognized standards, development of standard operating procedures (SOP) or standard operating guidelines (SOG) may be more practical to ensure consistent operational practices and increase emergency responders and community safety if an ethanol-blended fuel incident were to occur.

## *Retail Tank Configuration*

At retail sites, the most common tank configuration is horizontal underground tanks. The maximum pressure that any underground tank can hold is 0.5 pounds per square inch gauge (psig).

Tank capacities range from a few thousand gallons up to 20,000 gallons. These tanks are typically constructed of steel or double walled fiberglass. Emergency shut-off valves will vary for each container due to design and construction differences.

Loading and unloading points will vary due to design and construction. Risers for multiple tanks will be color-coded or marked to identify the product.

## *Summary*

In this module we learned that denatured fuel ethanol (E95-E98) is most commonly stored in storage tanks made of carbon steel. Denatured fuel ethanol can also be stored in stainless steel storage tanks, although these tanks are less common.

Pre-planning for potential incidents at liquid product terminals is extremely important. Emergency responders should develop good working relationships with the terminal operators and should be very familiar with their operations.

Liquid product terminals will likely be equipped with fixed fire suppression systems, it is important to remember that these systems could be rendered inoperable at the onset of an incident.

From the liquid product terminals, the ethanol-blended fuel arrives at local retail fueling stations mostly by cargo tank trucks. These stations will use underground and above-ground storage tanks.

Although the amount of fuel stored at each retail fueling station is small, especially when compared to liquid product terminals, the sheer number of retail fueling stations requires that an SOP or SOG be established to ensure safe and consistent operational activities during incidents. If possible, developing a pre-plan would be most advantageous.

# Activity 5.1: Ethanol in Your Jurisdiction

## *Purpose*

To allow participants to determine the potential for an ethanol emergency in their jurisdictions.

***Instructor Note:***

***Time:*** *10-12 minutes*

***Materials:*** *Worksheet 5.1*

***Instructor Directions:***

1. *Participants should work individually or in groups of two (if both are from the same jurisdiction).*
2. *Have participants read the items in Worksheet 5.1 and write down their answers.*
3. *After about five minutes call time and conduct a discussion covering each item.*
4. *As participants discuss the items, point out differences. Depending on the audience, it is likely that participants may have vastly different guesses for the number of retail stations in their jurisdictions.*

## *Participant Directions*

1. For this activity you will work individually or in groups of two.
2. Read the items in Worksheet 5.1 and write down your answers.
3. Be prepared to discuss with the class.

## Worksheet 5.1: Ethanol in Your Jurisdiction

1. Approximately how many people live in your jurisdiction? _____

2. How many retail fuel stations in your jurisdiction have been pre-planned?

   _____

3. Do you have any industries that would use or store large quantities of ethanol or ethanol-blended fuels? _____

4. If so, how many are there? _____

5. What are the likely routes ethanol will be transported to or through your jurisdiction?_____

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6. Compile a list of agencies in your jurisdiction that you can call upon during an emergency at a fuel storage or dispensing location.

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7. Based on all the information discussed in this class, what do you think would be the major concerns (logistical, mitigation, environmental, mutual aid, etc.) at an ethanol emergency at a retail fuel station in your jurisdiction? At a storage facility in your jurisdiction?

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